INTERNATIONAL RICE COMMISSION

NEWSLETTER

Vol. VII, No. 1 March 1958

CONTENTS

FOOD AND AGRICULTURE ORGANIZATION
REGIONAL OFFICE FOR ASIA AND THE FAR EAST
BANGKOK THAILAND

FAO AGRICULTURAL STUDIES

No.		Price in U.S.$
1	Breeding Livestock Adapted to Unfavourable Environments, by Ralph W. Phillips, 1948. 182 p.	1.50
2	Preservation of Grains in Storage, by Stephen S. Easter, 1948. 174 p.	1.50
3	Using Salty Land, by H. Greene, 1948. 49 p.	0.50
4	Soil Conservation – An International Study, by Mark Baldwin and collaborators, 1948. 189 p.	2.00
5	Nutritional Deficiencies in Livestock, by Richard T. Allman and T.S. Hamilton, 1948. 102 p.	1.00
6	Storing and Drying Grain in Canada, in the United States, in the United Kingdom, by L.E. Kirk, Lee Ling and T.A. Oxley, 1948. 41 p.	0.50
7	Better Utilization of Milk, by D.A. Soulides, 1949. 76 p.	0.75
8	Rinderpest Vaccines – Their Production and Use in the Field, by K.V.L. Kesteven (Ed.), 1949. 71 p.	1.00
9	Efficient Use of Fertilizers, by Vladimir Ignatieff, 1949. 183 p.	2.00
10	Some Important Animal Diseases in Europe – Papers presented at the Animal Diseases Meeting, Warsaw, 1948, by K.V.L. Kesteven (Ed.), 1949. 194 p.	2.00
11	The Consolidation of Fragmented Agricultural Holdings, by Sir Bernard O. Binns, 1950. 99 p.	1.00
12	Some Aspects of Food Refrigeration and Freezing, by Donald K. Tressler, 1950. 205 p.	2.00
13	Weed Control by Growth-Regulating Substances, by Lee Ling, 1951. 36 p.	0.50
14	Joint FAO/WHO Expert Panel on Brucellosis – Report on the First Session, 1951. 36 p.	0.25
15	Joint FAO/WHO Expert Group on Zoonoses – Report on the First Session, 1951. 48 p.	0.30
16	Improving the World's Grasslands, by A.T. Semple, 1951. 147 p.	2.00
17	Communal Land Tenure, by Sir Gerard Clausen, 1953. 57 p.	0.50

ROTATIONAL IRRIGATION FOR RICE – A REVOLUTION IN TAIWAN[1]

Lee Chow
Senior Engineer
Joint Commission on Rural Reconstruction
Taiwan, China

I. Introduction

THE sub-tropical climate in Taiwan makes it possible for farmers to grow two crops of rice a year wherever there is sufficient water for irrigation. The first crop matures in about four months in the first half of the year, while the second crop requires slightly less time in the second half. In South Taiwan the crop season is about one to two months earlier than that in the north. The conventional method of irrigation is a continuous flow, starting from the time of transplanting until ten days or two weeks before harvesting, except for weeding and fertilization when irrigation ceases. In hilly sections of the Island where canal systems do not exist, water flows down from upper fields to lower ones.

Such a practice results in high water consumption. During the early years when the Island was sparsely populated, water was plentiful and there was no need to restrict its use. But with the influx of people from mainland China, the need for more efficient use of water for crop growth began to be felt.

Since the Chinese-American Joint Commission on Rural Reconstruction—JCRR—began to operate in Taiwan in 1949, the extremely low duty of irrigation water in the Island, averaging only about four hundred hectares per cubic meter of water per second, immediately attracted the author's attention. His findings were published in 1951 (1). The study reveals that the conventional irrigation method can be replaced with an intermittant or rotational method without sacrificing the yield. By the latter method 20-30 per cent of water could be saved. This, together with more efficient use of rain-water and more satisfactory operation of the existing canal systems, might mean that 50 per cent more of water could be made available for crop production.

II. Experiment Stations and Demonstration Farms

An organization, known as the "Rotational Irrigation Promotion Commission", was formed in 1954 by the Government. All government agencies at the national, provincial and local levels that are concerned with food production are represented on this Promotion Commission. The Promotion Commission immediately established experiment stations and demonstration farms. The former is to determine the best rotation intervals and the most desirable amounts of water for irrigation in the different parts of the Island, while the latter is to demonstrate to the farmers that rotational irrigation is just as good as continuous flow, if not better. At present, in the Island there are three

1 *Readers may refer to "Irrigation Facilities for Rice Culture in Taiwan", by Y.H. Djang, published in the December 1957 issue of the News Letter.*

experiment stations, one in North Taiwan, one in Central Taiwan and one in South Taiwan. At one time there were eleven demonstration farms, the land of several of them having been converted into regular paddy fields under the rotational irrigation system.

The experiment station generally has a small area divided into plots. For example, in the Taoyuan Experiment Station, the plots are grouped together to receive four different treatments, each with four replications. The four treatments are irrigations at 6-day, 8-day, 10-day and 15-day intervals. A total of sixteen plots, each of 8 meters long and 2 meters wide, is required. The Station has cement lined ditches, water gates and measuring devices. The amount of water that should be applied to a particular plot can thus be exactly controlled and measured. For all different rotation intervals, 45 millimeter depth of water is applied for each irrigation. Clayey material was used to build the boundary dikes between the plots in order to prevent seepage losses. Precipation, temperature, humidity and sunshine are daily recorded. The drained off water is also measured. Surrounding the experimental plots a protection belt is provided. The Central Experiment Station was similarly designed, except for three important modifications. One is that there are eight replications instead of four for each of the four treatments. Another is an inclusion of a study on soil fertility. The third is that concrete dikes are used between the plots.

The demonstration farms are much larger in size, but the water use is not so perfectly controlled as at the experiment stations. They are designed to demonstrate to the farmers the relative merits between the rotational and conventional methods of irrigation and to determine possible difficulties that may be encountered in enforcement of the rotational method of irrigation on a large scale. In these demonstration areas some changes had to be made in the existing canal systems. Most of these demonstration farms were established on request in districts where the water supply was insufficient and unevenly distributed or water disputes constantly arose. As a result, water disputes have been very much reduced in the areas where rotational irrigation has been practised. The benefits derived from rotational irrigation for the lower portion of a canal system are especially noticeable since these lower areas usually suffered most in the past. For instance, in the area of the Tan Tsi Demonstration Farm in Central Taiwan, the land in the lower irrigation section was worth only half the value of the upper section. Now, the price is about the same in both places.

The rotational intervals of these demonstration farms vary from four to seven days. Before the irrigation season begins, a detailed irrigation schedule must be made to determine the amount and time of irrigation for each section of land in a given area. At times of serious water shortage, the rotation intervals will have to be correspondingly lengthened. When this happens the irrigation schedule will have to be changed. If any area remains unirrigated in any one round, it will be the first to receive water in the next round.

The Promotion Commission also conducted short term training courses to train people to prepare irrigation schedules, operate water gates, use measuring devices, and make proper adjustments in water distribution if necessary. The trainees were selected mostly from among the graduates of agricultural vocational schools.

The expenses for conducting the experiment stations and the demonstration farms were first wholly and later partly met by the goverment and the American aid agency. The expenditures for the experiment stations would usually cover the cost of fertilizers used, seed, land rent, labour and operation. In the case of the demonstration farms, the expenses would be mainly for operation, because fertilizers, seed and labour were to be provided by the farmers concerned.

The data for 1955, 1956 and part of 1957 have been gathered and analysed. This study involves a total of 17 cases in which a comparison had been made between the rotational and conventional methods of irrigation in depths of water application and unit yields of rice. They all showed consistently that the rotational method saved from 4 per cent to 231 per cent of water, with an average of 91.5 per cent. Five cases of rotational irrigation or 29 per cent showed a decrease in yield, varying from 2.5 to 12.3 per cent, with an average of 5.2 per cent. However, the remaining 12 cases, or 71 per cent showed an increase in yield varying from 0.3 to 31.3 per cent, with an average of 17 per cent. The result seems to indicate that the author's conclusion made in 1951 regarding the advantages of the rotational method of irrigation over the conventional method was a little too conservative. The increase in unit yields may be explained by better aeration and more oxidation due to the periodic drying of the field, thus making fertilizers more available to the crop. Moreover, less fertilizers are likely to be lost by surface drainage as in the case of the continuous flow.

Incidentally a survey made by an expert of the World Health Organization shows that malaria control has been made more effective in areas where rotational irrigation was in practice.

III. Definite Measures to Adopt the New Practice

The success of the experiment stations and the demonstration farms was not the only factor that led the government to adopt the rotational irrigation policy. It was the 1954-55 drought that prompted the Government to do so. That drought affected two crops of rice, the second crop of 1954 and the first crop of 1955. During the period of drought all canals in the Island carried only from one third to one half of their normal capacity. Due to the government order and the encouragement of the Promotion Commission, rotational irrigation is now practised almost throughout the Island, with remarkable success. To determine the result, however, an inspection team was organized in 1955 by the government, consisting of representatives of all agencies concerned. The findings were briefly reported in another paper (2). The team

recommended that rotational irrigation be adopted as a standard practice in Taiwan.

Subsequently, two actions were taken by the Government. One was the promulgation of an irrigation regulation in February, 1957. This regulation has 7 chapters and 57 articles. These chapters cover the following headings: "General, Irrigation, Drainage, Maintenance, Supervision, Penalty and Appendix". This is the first time that irrigation methods in Taiwan have been placed under regulation. The second chapter on irrigation refers mainly to rotational irrigation.

The other government action to enforce rotational irrigation was the formulation of a 4-year plan, in which a total of 112,808 hectares of paddy fields would have their irrigation systems improved so that rotational irrigation could be practised. The selection of these paddy areas is based on the existence of most reliable sources of water supply and the most frequent water disputes. After the plan was implemented, an isolated area of 10,850 hectares, usually with an insufficient water supply, had enough water and in addition another 9,075 hectares of land could be irrigated. This increase in production was 60,000 tons of paddy a year. The benefit cost ratio of this 4-year plan is estimated at 2.76

IV. The 1957 Program and Its Engineering Features

The 4-year rotational irrigation plan began in 1957. The first year program covered an improvement work on 17,824 hectares of paddy fields scattered over seven different districts. It called for NT$ 9,070,000 (approx. US$ 366,000) to be made available by JCRR. The improvement work consists of (1) installation of control structures and measuring devices, (2) modification of the existing irrigation system by transforming farm turnouts into sub-laterals, and (3) lining canals with cement. Some of the projects are completed and others underway. These projects will improve the existing systems and ensure the most effective use of water.

The rotational use of water may be accomplished in two ways: first, by rotating water supply in various reaches of a main canal, in laterals or in sub-laterals; and secondly, by rotating water supply among small areas, called rotation areas. In the first instance, when water is being conveyed in one stretch of a main canal or in one lateral, all the other reaches of the main canal or laterals would be dry. In the second instance, all the main canal, laterals, and sub-laterals would carry a continuous flow and irrigation would be rotated among the rotation areas. Various combinations of the two systems are also possible.

It has been demonstrated that rotation of water supply among rotation areas is a better method; because it calls for canals of smaller capacities, offers easier operation, creates less chances of water stealing and makes better use of the services of a common irrigator, which will be described later in the paper.

There is no single rule for determining the size of rotation areas. All such factors as topography, existing water courses, roads, soil conditions, agricultural practices and existing canal systems have to be taken into

consideration. The areas may vary from several hectares up to two hundred hectares. The canal capacities, however, may become the determining factor of these areas, if due consideration is given to soil conditions, evaporation and percolation data, and water requirements of the possible crops. The canal capacities can be determined at the lower end after taking into consideration the losses due to conveyance. In Taiwan the average size of a rotation area is about 50 hectares. The area is further divided into small rotation units, among which water supply is rotated. The time when each unit needs water supply varies directly with its area.

The canal conveying water to each rotation area is always provided with a headgate or turnout structure and a measuring device. The most common measuring devices are the Parshall Flume and the Standard Weir.

Monolithic concrete lining has been installed in canals and laterals to prevent seepage. Thin concrete precast slabs 5 cm., 6 cm. and 7 cm. thick have also been used, and they are cheaper. These latter linings thus far have proven satisfactory and should last long, although it may be necessary to keep them in good repair.

A complete irrigation system, with reservoirs or ponds for storage and under efficient management together with a well designed and supervised operation schedule, will be able to reduce water losses to a minimum and to utilize water most effectively.

V. The Common Irrigator and the Common Seedling Bed

Engineers and agriculturists should cooperate with each other in order to obtain the maximum irrigation results. The success of irrigation also depends on farmers' ability to work together and to manage their farms cooperatively. This can be illustrated by the following examples:

Under the Chia-nan Irrigation Association in southern Taiwan, a practice of employing common irrigators has been developed by the farmers within a rotation area to take care of their irrigation work, such as diverting and distributing water, maintaining farm ditches etc. These irrigators are usually farmers selected by themselves within the rotation area. They are generally industrious, impartial and familiar with the farming conditions in the area. For each rotation area of say 50 hectares, two common irrigators may be necessary. The whole area is under their care. They know what fields need special adjustments in the rotation system and how much water is required by reason of soil conditions or other factors. At the start, the common irrigator may experience some difficulties, but before long, he will acquire the necessary skill and experience.

It was estimated that the employment of a common irrigator would save for an average farmer about five sixths of the time required for irrigation under the old practice. Thus, with a total irrigation period of 90 days, on a 6-day rotation interval, one half of a man-day is required for each irrigation of 0.33 hectare and the total labour required for a 50-hectare rotation area would be 15 ×

0.5 × 50/0.33 or 1,125 man-days. If two common irrigators are employed, the total labour required would be 90 × 2 or 180 man-days. This saving on man power mean a good deal to the farmers, and reduce the cost of production considerably.

The common seedling or nursery bed for rice is another development that can very well be incorporated into the rotational irrigation practice. The local practice is to place the seeds in the seedling bed one to two months before transplanting. Such beds are privately owned. Each farmer has his own way of farming. The need for proper seed treatment, nursery bed preparation, and other improved farming practices has developed the use of common seedling beds. Although the common seedling bed has not been widely used, its advantages are very obvious. Further demonstration work was carried out during 1955-1956. A total of 101 such common beds (12 in South Taiwan and 89 in North Taiwan) was installed with a combined area of 16,984 hectares. The seed beds constitute about one twenty-fifth of the planted area. The trial results indicate that the farmers in North Taiwan are reluctant to adopt the practice due to the travel distance between the seedling bed and the planted area. But in southern Taiwan where the spring is usually dry, the common seed bed idea is more readily acceptable as the farmers need to locate their nursery beds in places of more dependable water supply.

The use of the common seedling bed can very well be incorporated into rotational irrigation because the age of the seedlings can be perfectly controlled so as to fit in with the irrigation schedule. The farmers should also work together cooperatively by forming teams for transplanting according to the seedling development and the irrigation schedule. It is very important in rice culture to transplant the seedlings at the proper time.

VI. Difficulties and Problems

The practice of rotaional irrigation in Taiwan is not without difficulties. Some of them can be easily overcome, while others will take time to solve. The most common difficulty lies in the fact that the people along the upper end of an irrigation system are oftentimes not interested in the program and even object to it since they have not previously experienced water shortage. The use of water was rarely controlled or limited in the past. The new method would therefore cause some inconvenience. Some farmers tried to interfere with its development. In two cases the farmers demolished the new structures. In modifying a conveyance system, a farmer's direct turnout from the main lateral might have to be abolished and instead his water supply might have to come from the lower end of a new lateral. Certainly this would disturb him. In digging the new lateral to modify the old system, right-of-way problems are also encountered. Land owners often refuse to give up their land even for a good compensation.

There are conflicts between irrigation and peak power generation. This is more so with rotational irrigation. Peak power is usually genetated during low river stages by storing the natural river flow during day time and releasing it during a few hours of peak electric load in the evening. This is in

conflict with irrigation not only because this is also a time when the irrigation requirement is at the greatest, but also because the natural river discharge is changed into a highly fluctuating flow. This is especially undesirable in the case of rotational irrigation because the irrigation schedule is devised according to a known discharge which is usually fairly uniform. Furthermore, surges often result in wasting water down the river channels because the canals cannot cope with the large peak flows. This situation can be improved only by construction of an afterbay for re-regulation of water below the power plant.

Some people believe that rotational irrigation is likely to encourage weed growth. It is reasoned that continuous irrigation will prevent weed growth. After two or three weedings, weeds will not easily grow under standing water. With rotational irrigation soil is more often exposed and so weeds grow more easily. This problem is now under close observation.

Some field workers think that rotational irrigation will increase the incidence of rice blast disease. Thus far, there has been no evidence of this in Taiwan.

The difficulties and problems mentioned above are not considered serious in the enforcement of rotational irrigation. They do point out, however, that further studies on them are desirable.

Acknowledgement

Thanks are due to Mr. T.R. Smith, Chief of Irrigation and Engineering Division, JCRR, who has read this manuscript and made many suggestions. He also has general supervision of the whole program of rotational irrigation in Taiwan.

References:

(1) JCRR Engineering Series No. 3, "Rotational versus Continuous Irrigation Methods for Taiwan", by L. Chow, 1951, revised in 1953.

(2) "Rotational Irrigation in Taiwan", by L. Chow, August 1955, Free China Review.

EFFECTS OF WATER DEPTH ON THE GROWTH AND YIELD OF LOWLAND RICE

Julian Bulanadi and Primo B. Aldaba

Bureau of Plant Industry
Manila, the Philippines

I. Introduction

One of the problems that most rice growers face is water for irrigation. All kinds of irrigation system, whether by gravity or by pumping, are expensive, and therefore not extensively employed, in spite of an urgent need.

In the Philippines, the present irrigation system for rice cultivation is far from adequate. In view of the expense involved

in obtaining water for irrigation, it is exceedingly important to find out the optimum amount of water required for maximum rice production so that water can be used more econmically and efficiently.

Previous studies on the influence of intermittent irrigation and different water depths on rice yield in the country have been reviewed. Gordon (1) reported in 1929 that *Guinangang*, an early maturing variety, required an average depth of 10.1 centimeters of water during its entire growing period. Borja et al (2) found in 1952 that early and medium late varieties produced best in water 6 centimeters deep and that late maturing varieties would require twice the amount of water. In 1954, another study was carried out in the Maligaya Experiment Station and the result shows that *Wagwag*, a late maturing variety, was doing best in water 10 centimeters deep.

The present study between the U.P. College of Agriculture and the Bureau of Plant Industry was initiated in 1955 by Paul R. Hoff, a Visiting Professor, from Cornell University, in the Department of Agricultural Engineering, U.P. College of Agriculture, with a view to determining how to use water more efficiently for rice production.

II. The Experiment

The experiment was conducted in three places: the Maligaya Experiment Station, the Lamao Experiment Station and the College of Agriculture at Los Banos.

In the Maligaya Experiment Station, there are ten concrete-dike plots arranged in a row, each 2 meters by 25 meters. Each plot was sub-divided into 4 sections, 2x5 meters each, with a vacant space of 1 meter wide between sections to avoid possible mixtures.

Four leading varieties—*Apostol, Macan, Raminad* 3 and *Wagwag*—were chosen. The seedlings were transplanted at 33 to 37 days old. The same number of seedlings was planted to each hill, spaced at 20 centimeters apart within the row and 30 centimeters between rows.

Plots Nos. 1 to 5 were given the intermittent irrigation treatment under a schedule of 15 days of irrigation followed by 5 days of drainage, while plots Nos. 6 to 10 were given a continuous flow at 5 different levels: 5 cm., 10 cm., 15 cm., 20 cm., and 0 cm. (using moist soil as control). All these levels of water were randomized.

All the plots, prior to weeding and fertilization, were temporarily drained. Equal amounts of fertilizers (16–20–0) were applied to all the plots at the rate of 150 kilos per hectare. To prevent infestations of army worms and other pests, DDT was sprayed uniformly at a concentration of one table-spoonful to a gallon of water.

III. Results Obtained

Observations were made on the development of tillers after each irrigation and drainage during the growing period, by taking on the average 4 hills per variety. The last observation was made 78 days after transplanting.

Height of Tillers as Affected by Irrigation Treatments. The differences in the

height of tillers among the different trials, after the first 15 days of irrigation and also after the first 5 days of drainage, were insignificant. Similarly, there were no significant differences among the four rice varieties under experiment. However, after the second irrigation, some highly significant differences were observed in the height of tillers among the four varieties. After the last irrigation, the difference between the mean height of the tillers of *Macan* (165.80 cm.) and *Wagwag* (116.60 cm.) was highly significant. But there were no significant differences observed in the height of tillers among the five different water depths.

Similar observations were made on the continuous irrigation plots. After 20 days of continuous irrigation highly significant differences in the height of tillers were noticed; while the differences among the different water depths were not very significant. After 35 to 40 days of continuous irrigation, highly significant differences in the height of tillers among the different treatments began to appear, and the differences among the varieties were much more significant.

The difference in the height of tillers seems to be due to varietal characteristics rather than to the influence of water depth. It appears, however, that there is a tendency for all varieties under trial to produce longer straw under the intermittent irrigation treatment.

Number of Tillers as Affected by Irrigation Treatments. The differences in the number of tillers produced under the various levels of water depth after the first 15 days of irrigation were insignificant, although there were however highly significant differences among the varieties. After the first 5 days of drainage, there were no significant changes among both the treatments and the varieties. After the second and third irrigations and drainages, still no significant changes were observed, but the number of tillers due to varietal differences was very noticeable. 78 days after transplanting, the number of tillers of each of the four varieties under trial were counted as follows: *Wagwag*, 32 tillers; *Raminad*, 31.00; *Apostol*, 22.60; and *Macan*, 22.40 tillers.

Similar observations were made on the plots under continuous irrigation. After the first 15 days of irrigation, the difference was more conspicuous among the different varieties than among the different irrigation treatments. After 20 days of continuous irrigation, however, there were pronounced differences between the 5 cm. and the 20 cm. water depths.

Later observations in the field showed no more significant changes. 78 days after transplanting, *Wagwag* produced an average of 37.60 tillers; *Raminad*, 25.60; *Apostol* and *Macan* both 22.00 tillers.

Yield as Affected by Water Depths. In the plots under the intermittent irrigation treatment, the differences in yield among the five water levels as well as among the four varieties were insignificant. Similarly the plots under continuous irrigation showed no significant differences in yield among the different water levels and also among the varieties.

It can be concluded that the result of the experiment indicates that all four varieties produced higher yields under intermittent irrigation than under continuous flow. Statistically, the differences in yield may be insignificant, but to practical farmers, such differences mean a good deal.

Literature Cited:

1. Gordon, Alexander. A summary of studies on the depths of irrigation water. Philippine Agriculturist. 17: 579-592. 1929.
2. Borja, V., J.P. Torres and F.P. Octubre. Fifty years of rice research. A Half-Century of Philippine Agriculture XIX & 463. Bureau of Plant Industry. 1952.
3. Aglibut, Andress P. and Paul R. Hoff. Effects of continuous submergence on rice lodging and yield. The Philippine Agriculturist, 39: 453-464. 1956.

LIME AS A REMEDY FOR A PHYSIOLOGICAL DISEASE OF RICE ASSOCIATED WITH EXCESS IRON

F.N. Ponnamperuma

Department of Agriculture
Peradeniya, Ceylon

A physiological disease of rice, known as "bronzing" or "browning" disease, occurs widely in low lying paddy fields of the ultra wet zone (the south western region) of Ceylon.

The symptoms appear about two months after planting in the flooded soil. The most obvious of these is a discolouration of the older leaves, which starts at the tip and spreads along the leaf margin, leaving the midrib region green. The tints on affected leaves vary with the variety but are usually purplish or orange. Brown spots are also seen on the upper halves of the laminae of the older leaves. As the disease progresses the affected leaves dry up giving the plant a scorched appearance. In severe cases growth is markedly retarded. More commonly, growth is not seriously affected but the final yield is low owing to the presence of a high proportion of sterile florets. The root system of diseased plants is scanty, coarse, and dark brown. The incidence of the disease is higher during the *yala* season (S.W. monsoon) than in *Maha* (N.E. monsoon).

The disease occurs on a variety of soil types ranging from sands at one extreme to clayey and peaty soils at the other. Common features, however, of these soils are: (1) a low pH (pH values range from 4.3 to 4.9); (2) a high content of iron oxide; (3) poor drainage; and (4) contiguity with the ferruginous laterite highland.

The results of an investigation reported elsewhere (1, 2, 3) indicated that: (1) symptoms very similar to those described

above were associated with a high concentration of ferrous iron in the soil solution; and (2) lime prevented the build up of a high concentration of iron and the appearance of these symptoms. Lime as a remedy for "bronzing" or "browning" disease of rice was therefore tested on a poorly drained, acid, lateritic clay.

The soil used had the following chemical characteristics:

pH	4.43
Cation exchange capacity	7.10 m.e. per 100 gm.
Total exchangeable bases	0.72 m.e. per 100 gm.
Organic matter	4.35 per cent
Nitrogen	0.17 per cent
Free iron oxide	0.125 per cent

The effect of slaked lime applied two weeks prior to sampling, on the pH value of the soil, is shown below:

Slaked lime (tons/acre)	0	3	6
pH	4.43	5.89	6.73

The influence of lime at these three levels on a susceptible variety, *Murungakayan* 302, was tested over a basal dressing of 100 lbs. ammonium sulphate, 50 lbs. concentrated superphosphate, and 50 lbs. muriate of potash in a field experiment in *Maha* 1956-57.

The limed treatments were conspicuous by their luxuriant growth and the absence of the leaf symptoms manifested in varying degrees by the unlimed treatments. Yields are summarized in Table I.

Table I

Slaked lime (tons/acre)	0	3	6	S.E.
Mean yield (bushels/acre)	45.5	50.7	61.5	1.00

The experiment was repeated on the same plots in *Yala* 1957 with another susceptible variety *Mas* M24. The lime application was not repeated. Basal dressing of fertilizer was the same as in the previous experiment. Yields are summarized in Table 2.

Table II

Slaked lime (tons/acre)	0	3	6	S.E.
Mean yield (bushels/acre)	38.9	49.1	56.4	1.24

A green house study with soil from the same field and also with a sandy loam, pH 4.8, from another location where the disease occurs, subjected to the same lime treatments, is in progress.

All pots received a mixture of ammonium sulphate, concentrated superphosphate, and muriate of potash at the following rates:

Amonium sulphate	: 100 lbs. at planting	per 2,000,000 lbs. of soil
	100 lbs. 30 days before heading	
Concentrated superphosphate	: 200 lbs. at planting	
Muriate of potash	: 100 lbs. at planting	

The pots were kept flooded and rice seeds (variety *Mas* M24), dibbled in the soil.

Yield figures are not yet available but some observations can be reported below.

Seven weeks after sowing a slight reddish discolouration of the tips of the older leaves was noticed in the unlimed pots, but the plants as a whole was darker green than those in the limed treatments. A week later, the reddish colour had turned to brown and the tips were drying up. In two of the unlimed replicates brown spots were visible on the upper halves of the laminae of the older leaves, especially at the tips and along the margins. In one replicate there was a marked scorching of the tips and margins of the older leaves.

Eleven weeks after sowing marked differences were noticeable between the limed and unlimed treatments. The drying up of the older leaves had advanced considerably in the unlimed pots so much so that it was possible to recognize them easily by the mass of brown, dead, leaves. By this time even the second leaf from the top of plants in the unlimed pots was showing tip and marginal scorch. Just below the scorched tip the laminae was reddish in colour. Also brown spots and streaks were clearly visible in all but the newest of the functioning leaves.

These symptoms were noticed in a very mild form in the pots which received lime at 3 tons per acre but not in the 6 tons per acre lime treatment. The plants of the limed treatments were generally lighter green in colour and more erect and taller than those of the unlimed treatment. They headed and flowered earlier than plants of the unlimed treatment. A marked increase in yield in the limed treatments over the unlimed treatment is anticipated.

Chemical studies on the percolates from the pots show, among other things a higher concentration of soluble iron in the unlimed treatments. This is shown in Table 3. Corresponding figures for the sandy loam, pH 4.6, are given in Table 4.

Table III

(Clayey Soil pH 4.43)

Fe^{+2} in p.p.m. in Soil Solution

	Days from start				
Lime (tons/acre)	*0*	*30*	*60*	*90*	*120*
0	0.3	7.3	40	122	243
3	0.3	0.5	37	48	80
6	0.3	0.3	32	26	45

Table IV

(Sandy Loam pH 4.76)

Fe^{+2} in p.p.m. in Soil Solution

	Days from start				
	0	*30*	*60*	*90*	*120*
Lime (tons/acre)					
0	0.3	12.0	33	122	208
3	0.2	3.0	33	95	95
6	0.3	0.7	38	51	55

It is clear from these figures that plants in the unlimed treatments have been subjected to a much higher concentration of soluble iron than those in the limed treatments. Growth was poorer and symptoms of "browning" disease were also clearly visible in the plants grown on the unlimed soils.

Ammonium, nitrate, and manganese were also determined in the percolates from the pots.

Ammonium tended to be slightly higher in the unlimed pots than in the limed. This was probably a reflection of reduced uptake by plants of the unlimed pots, associated with unfavourable soil conditions.

Nitrate tended to be higher in the limed treatments during the first eight weeks. Thereafter it was reduced to a level of less than 0.5 p.p.m. for all treatments.

Manganese was slightly higher in the unlimed treatments but at no stage did the difference between the highest and lowest manganese concentrations exceed 3 p.p.m. in the soil solution.

The analytical figures suggest that "browning" disease is associated with excess iron in the soil solution. But further studies are necessary to prove that excess soluble iron is the cause of the disease. Whatever the cause, the results of greenhouse and field experiments show that the appearance of "browning" disease of rice on acid ill drained lateritic soils of the ultra wet zone of Ceylon can be prevented by previously liming the soil to a pH of about 6.

References:

1. Nature 175: 265, 1955.
2. The Joint Meeting of IRC Working Parties on Fertilizers and Rice Breeding, Penang, 1955.
3. Sixth International Congress of Soil Science, Paris, 1956, Reports: 503–506.

TIME AND METHODS OF APPLICATION OF UREA[1]

In recent years the production of urea in Japan has been increasing very rapidly, because the cost of production is much lower than that of sulphate of ammonia for the same amount of nitrogen. This will be more so when the volume of production becomes larger. In 1957 the production target was about 300,000 tons. For practical reasons, the increase in urea production is very much welcomed, because urea is not only equal to sulphate of ammonia, but it is preferred to the latter as a nitrogenous fertilizer for degraded paddy fields as well as for acid soils.

However, farmers in general are rather reluctant to use this new fertilizer. There have been no comprehensive experiments carried out in the country on the methods of application. Moreover, the results of some experiments are often inconsistent.

Urea is not an electrolyte, and so it cannot be absorbed by the soil as easily as ammonium sulphate. The present experiment, started in 1956 and still continuing, aims at finding out the most appropriate time and methods of placement of urea as a fertilizer. The different treatments were arranged as follows:

a. Number of experimental sites: Twelve, scattered all over Japan.

b. Replications: Three to four in randomized blocks.

c. Design:

1. No nitrogen.
2. Urea deeply placed and irrigated immediately.
3. Urea deeply placed and irrigated three days later.
4. Urea deeply placed and irrigated five days later.
5. Urea deeply placed and irrigated seven days later.
6. Urea deeply placed and irrigated ten days later.
7. Irrigated, harrowed, urea applied on the soil surface just before transplanting.
8. Sulphate of ammonia deeply placed and irrigated five days later.
9. Irrigated, harrowed, sulphate of ammonia applied on the soil surface just before transplanting.

Note:

P and K were applied in sufficient amounts.

The result of the experiment in 1956 can be expressed in brown rice in Table 1.

1 Contributed by the Ministry of Agriculture and Forestry, Government of Japan.

Table 1

Site	Plot No 1	2	3	4	5	6	7	8	9
1. Shiga Agr. College	2.22	2.86	2.79	2.70	2.63	2.28	2.73	2.78	2.92
2. Okayama Agr. Expt. St.	2.10	2.72	2.66	2.44	2.38	2.30	2.37	2.44	2.51
3. Yamaguchi Agr. Expt. St.	1.45	1.76	1.61	1.57	1.52	1.39	1.80	1.70	1.75
4. Ehime Agr. College	2.60	2.97	3.19	3.53	3.72	3.33	2.72	3.50	3.03
5. Kyusyu Agr. Expt. St.	2.51	2.92	2.80	2.69	2.62	2.55	2.78	2.64	2.81
6. Kagoshima Pref. Agri. Expt. St.	2.15	2.72	2.68	2.65	2.29	2.21	2.67	2.53	2.65
7. Tohoku Agr. Expt. St. (Omagari)	2.51	3.53	3.61	3.47	3.52	3.63	3.31	3.65	3.51
8. Miyagi Pref. Agr. Expt. St.	1.95	3.04	3.05	2.98	2.91	2.93	2.93	2.98	3.06
9. Ishikawa Pref. Agr. Expt. St.	2.30	3.90	3.72	3.77	3.69	3.52	3.58	3.76	3.68
10. Nagano Pref. Agr. Expt. St.	2.41	3.14	3.20	3.11	2.91	2.88	3.37	3.25	3.05
11. Kanto-Tosan Agr. Expt. St.	1.49	2.56	2.47	2.35	2.40	2.12	2.19	2.37	2.22
12. Aichi Pref. Agr. Expt. St.	2.33	3.04	3.06	2.94	3.02	2.89	2.76	3.09	2.74
Total	26.02	35.16	34.84	34.20	33.61	32.03	33.21	34.69	33.93
Mean	2.16	2.93	2.90	2.85	2.80	2.66	2.76	2.89	2.82
Yield index	73.7	100	98.9	97.2	95.5	90.7	94.1	98.6	96.2

From the above table the following observations can be made:

1. Urea, when deeply placed and irrigated immediately, gave the highest yield. The longer the delay of irrigation water, the lower the yield. This seems to be contrary to the usual expectation. Ordinarily the belief is that urea is not absorbed by soil colloids, and if the field is irrigated right after its application, it may be washed away from the placement. Therefore, it will be better to delay irrigation for several days for urea to decompose into ammonium carbonate. But this was not so in this case. This phenomenon could be explained by the fact that nitrification, especially in South Japan, takes place very rapidly, and any delay of irrigation would result in a loss of ammonia through the process: urea-nitrification-denitrification-leaching out.

2. Although deep placement of both urea and sulphate of ammonia is superior to surface application by 6% and 2.5% respectively, it is hardly significant enough in the first year trial.

3. In comparing urea with sulfate of ammonia under similar conditions, sulfate of ammonia is slightly better than urea, although the difference is insignificant.

4. The relative merits between top and basal dressings would have to be found out in further tests.

IMPRESSIONS OF AGRICULTURAL EXTENSION WORK IN THE UNITED STATES OF AMERICA

C.W. Chang

Agricultural Adviser
FAO Regional Office for Asia and the Far East
Bangkok, Thailand

My trip to the United States of America in the summer of 1957 took me to Honolulu, Hawaii; Los Angeles, California; Purdue University, Indiana; Cornell University, New York; and the U.S. Department of Agriculture, Washington, D.C. In all of these places, I spent a total of three weeks interviewing extension specialists and making field observations. At Cornell University, I had the privilege of observing several classes in the summer school for extension workers and also in New York State of participating in a farm business study tour in Madison County. In the following pages, I shall try to state some of the general impressions I received during these brief visits.

I. A Productive Agriculture on a Sustained Basis

Twenty-five years ago, when I was studying at Cornell University, Ithaca, New York, I could see abandoned farms here and there in the State, and evidences of serious soil erosion and depletion. But now, as a result of years of effort in agricultural extension, soil conservation, agricultural conservation program, and other government services, the picture is completely different. In driving around anywhere in the eastern states, one will be deeply impressed by the amount of vegetative growth, not only completely covering the soil to prevent erosion, but giving the country a most scenic picture.

On every farm there are woodlots, grass land, and crop fields according to land use capabilities. The point is to convert submarginal land to grass and trees on one hand, and to bring good land under cultivation on the other. It was reported that for the past five years the average annual net reduction in cropland in the country, through conversion to forests or permanent pastures, was about one million acres a year. It was further estimated that there were still 52 million acres of land in the country that should be converted to long-term vegetative cover, either in grass or trees.

Agricultural production in the U.S.A. is generally carried out most efficiently. In its early history, nine working persons out of ten were in farming, as it is now in most Asian countries. Today, only one working person out of ten is in farming. A century ago, one person in farming provided food and fiber for himself and three others. Today, one farmworker provides for himself and twenty others, and still the country has a surplus for export. Without this progress in farming efficiency, the present development of big cities and industries in the country would never have been possible.

Agricultural exports in 1956 were valued at $3\frac{1}{2}$ billion dollars. For the year 1955, the United States share of world exports was as follows:

Cottonseed and oil	80 %
Lard and tallow	75 %
Soybeans and oil	67 %
Grain sorghums	93 %
Corn	48 %
Cotton	22 %
Tobacco	39 %
Powdered milk	57 %
Wheat and flour	32 %

II. A Mighty Government Machinery for Agricultural Development

The improvement of agriculture in the United States is a cooperative undertaking between the Federal and State governments. In the Federal Government there is the Department of Agriculture, which administers such services as agricultural research, cooperative extension, forest, soil conservation, farmer cooperative, agricultural marketing, foreign agriculture, and commodity stabilization. All these services are carried out on a tremendous scale, aiming at bringing about a prosperous, expanding and free agriculture.

For example, take the Farmer Cooperative Service. The main objective of the Service is to help farmers to help themselves in their marketing and buying. At present the Service touches the economic lives of three out of five farmers through its research, service and educational activities; and has a deep influence on the agricultural economy of the entire country. Cooperatives market about $ 7 billion worth of farm products and handle about $ 2 billion worth of farm supplies a year. A recent survey of some 10,000 farmer marketing and farm supply cooperatives shows farmers' investments amount to nearly 59 per cent of total assets, borrowings comprise a little over 25 per cent, and other liabilities amount to 16 per cent. Cooperatives, according to this study, make extensive use of the revolving fund method of financing.

Another example is the Foreign Agricultural Service in the U. S. Department of Agriculture. This Service is designed to help the agricultural industry build a flourishing export business, based on competitive quality and price and on sales for dollars. As mentioned earlier, the total value of agricultural exports in the country in 1956 amounted to $ $3\frac{1}{2}$ billion. In order to carry out the international trade intelligently, the Service receives regular reports from 86 agricultural attaches, stationed at 56 posts, and covering 107 countries and areas. These reports are promptly analysed, interpreted and made available to the agricultural industry through publications, the farm press, and radio and television outlets. Such information gives the United States a better knowledge of how and where to seek and maintain markets for farm products.

III. More Trained Personnel in Need for an Expanding Agriculture

Agriculture of today in the United States is no longer confined to the narrow sense of the word. It supplies the American people their food, most of their fiber, and some of their building materials. It is a science, a business, a profession, an industry! It provides more jobs and careers than any other industry. Of 62 million employed Americans, 25 million produce for and service farmers, and 9 million process and distribute farm products. In addition, a quarter-million scientists directly serve agriculture. About 40 per cent of all jobs are found in more than 500 distinct occupations in agriculture.

According to the survey made by the Association of Land-Grant Colleges and Universities and published in a booklet, known as "Careers Ahead", in 1955, the annual demand for new college graduates in agriculture in the country is 15,000, while the supply is only 8,500. The 15,000 new jobs that will be available each year can be shown in the following 8 fields :

1.	Agricultural Research	1,000
2.	Agricultural Industry	3,000
3.	Agricultural Business	3,000
4.	Agricultural Education	3,000
5.	Agricultural Communications	500
6.	Agricultural Conservation	1,000
7.	Agricultural Services	1,500
8.	Farming and Ranching	2,000
	Total	15,000

IV. A Broad Approach to Agricultural Problems

In 1956, the Extension Service in New York State was separated from the Farm and Home Bureau, which is a private organization, and a New York State Extension Service Advisory Council was established. As the name implies, the Council, which represents all the farming population in the State, gives advice to the State Director of Extension on matters pertaining to extension principles and policies. It tries to answer such questions as: 1) With what audience should extension be working? 2) What is the scope of the extension program? 3) Is it too narrow or too wide at the present time? 4) Is the present program reaching the people it is designed for? and 5) How can the program be evaluated? Similarly, there is the National Agricultural Advisory Commission to give advice to the Secretary of the U.S. Department of Agriculture.

In 1955, a Farm and Home Management Club was organized in Madison County, New York, to study farm business efficiency. The members of the Club have to keep cash account and inventory books. Both husband and wife are urged to attend summary and analysis meetings. The figures on individual business are kept strictly confidential, but the group averages are given wide publicity for comparison.

In recent years, more emphasis has been placed on production economy and such related farm activities as processing

and marketing than on production techniques, which have been highly developed over the past few decades since the passage of the Smith-Lever Extension Act in 1914. This can be illustrated by listing as follows the specialist positions, as now established, in the State College of Agriculture at Cornell University:

Department	*No. of Specialists*
Agricultural Economics	22
Agricultural Engineering	13
Agronomy	9
Animal Husbandry	17
Conservation	5
Dairy Industry	6
Entomology	9.5
Extension Teaching	15
Floriculture	8
Plant Breeding	3
Plant Pathology	10.5
Pomology	5
Poultry Husbandry	6
Rural Sociology	8
Vegetable Crops	7
Total	144

For the fiscal year ending 30 June 1957, the total amount of funds for the Cooperative Extension Service in the country was $122,552,663. Of this amount, 43.7 per cent was from Federal appropriations and 56.3 per cent from state and other resources. In 1955 there were in the country 10,800 county extension workers, assisted by 2,400 state agricultural and home economics specialists. In addition there were 1,235,000 local leaders, who voluntarily contributed their time and services to the extension work.

More recently, more than half the states, in close cooperation with the U.S. Department of Agriculture, have undertaken a more comprehensive program of rural development in selected low-income areas. Rural development committees, made up of representatives of agricultural and non-agricultural agencies, were formed in 19 states. Pilot counties where basic farm-town development work is underway were singled out by state leaders in 21 states. In 1957 the U.S. Department of Agriculture has provided $460,000 for payment to state extension workers for intensive extension work in those pilot areas.

All other agencies of the U.S. Department of Agriculture concerned with the Rural Development Program of the Department are cooperating and contributing

technical assistance. Such other Federal departments as the Interior; Commerce; Labour; Health, Education and Welfare also play a vital role in the program. In many aspects the Rural Development Program is similar to the rural community development projects presently going on in most Asian countries.

V. An Impressive Farm Business Study Tour

On 9 July 1957, a chartered bus took the farm business class in the summer school for extension workers at Cornell University on a study tour to Madison County, New York. The professor of the class led the tour. A soil specialist, also from Cornell University, and the County agricultural agent were also in the group, which I had the privilege of joining.

Shortly after the bus took off, pertinent publications were distributed to the class. With a microphone outfit in the bus, the professor, with the assistance of the soil specialist and the county agent, helped to explain the soil conditions and general farming problems as we saw them on both sides of the road all the way through to Madison County. It appeared that they were throughly acquainted with all the farm operators and their farming problems.

In Madison County we stopped at several dairy farms, talking with the farm operators and reviewing their farm business. Their capital outlays were big, ranging from $26,420 on one farm to $57,218 on another farm. They all raised dairy cows and grew their own feeds. On one of the farms we were served cold drinks at the operator's home, while on another farm we had our picnic, together with the farm family. Afterwards, there was an interesting discussion on the farm business, led by the farm operator, the county agent and the professor of the class. They all spoke to each other in common terms.

IV. Training Programs for Extension Workers

In 1956 in New York State, there was a total of 532 extension workers and their training can be classified as follows:

	No degree	*Bachelor's degree*	*Master's degree*	*Ph.D.*	*Total*
County agricultural staff	0	143	12	1	156
County home economics staff	0	86	14	1	101
County 4-H staff	2	92	7	0	101
State agricultural staff	0	18	25	108	151
State home economics staff	0	4	18	3	23
Total	2	343	76	111	532

From the above table, it can be seen that the level of training of the extension workers in New York State is very high, with 64 per cent having Bachelor's degree and 36 per cent having advanced degrees. In New York State, it is now required that an extension worker must be a college graduate, well versed in agricultural sciences,

in order to be able to cope with complex farming situations.

In addition to some 14 institutions in the country offering special graduate programs for extension workers, there are now five regional summer schools for them. These schools are located in New York, Wisconsin, Texas, Colorado and Arkansas, under the joint sponsorship of the U.S. Department of Agriculture and the State colleges concerned. In general, the following courses are offered in these summer schools:

1. Principles and Techniques in Extension Education
2. Organization and Development of Extension Program
3. Individual Farm and Home Development
4. 4-H Club Organization and Procedure
5. Working with Groups in Extension
6. Extension Communications
7. Evaluation of Extension Work
8. Farm Policy.

The schools last for three weeks each, and one can get credits for courses taken. There are many scholarships and other financial aids provided for those who are in need.

VII. An International Training Center for Visiting Specialists

Since 1944, a total of 5,152 people, including 4,425 men and 727 women, from 100 countries in the world have obtained their training in agricultural and home economics work in the U.S.A. through the sponsorship of the Foreign Educational Branch, Division of Extension Research and Training, Federal Extension Service, U.S. Departent of Agriculture. Of these, 901 came from 14 countries in Asia and the Far East and they are distributed as follows:

Burma	28
Ceylon	8
China (Taiwan)	123
India	218
Indo-China[1]	7
Indonesia	90
Japan	78
Korea	29
Malaya	6
Nepal	8
Pakistan	84
Philippines	148
Thailand	73
Viet-Nam (South)	1
Total	901

1 Before the three states of Indo-China became independent.

These people were supported by the International Cooperation Administration (I.C.A.), the Food and Agriculture Organization of the United Nations (F.A.O.), or some other agency.

In this connection, it is of interest to note that there is a special one-year course designed to train trainers in the processes of extension education for work in lesser developed countries. This is conducted by Cornell University, in cooperation with the Ford Foundation, for an initial period of three years, beginning from the fall semester of 1955.

The program of study for each student in the special one-year course is developed through personal counselling, taking into account professional interests, background of experience, formal study, probable future work, and major professional needs. In general, the curriculum includes those basic courses of study which one can select from the offerings of the entire university to meet his professional needs, a special seminar and a summer field study. The latter two courses are required for all students.

The enrollment of each of the three years under review is limited to fifteen students. The names of those students who came from Asia and the Far East are listed as follows:

1955–56 Class

Prem S. Sharma, Himachal Pradesh, India
Prasanta S. Majunder, West Bengal, India
Gul Mohammed Sheikh, Pakistan
Fransisco C. Panganiban, Philippines

1956–57 Class

J. B. Chitambar, India
Joh Chiba, Japan

1957–58 Class

Claire Gilbert, India
Amrick Singh (Chuma), India
T.P. Singh, India
Phanam Smitananda, Thailand

VIII. Alert for Improvement

The effectiveness of any extension work rests, among other things, on a sound program of work and suitable methods of implementation. The whole procedure of program planning and execution, as now practised in the United States, can be stated as follows:

1. Collect facts
2. Analyse situation
3. Indentify problem
4. Decide on objectives (what to accomplish)
5. Develop a plan of work
6. Follow through the plan of work
7. Determine progress or results (evaluation)
8. Make adjustments.

In general the county agent in the United States spends about 22 per cent of his time on extension organization and program planning. He uses as many different methods of extension as he can to get his message to the people. The greater the number and type of contact he has with a subject, the greater are the chances that he will put a recommended practice into use. Some of these methods used by county workers in 1955 were reported as follows:

1. Personal contacts	– 21,648,000 times
2. Telephone calls	– 9,494,000 times
3. Office calls	– 8,039,000 times
4. Farm and home visits	– 4,114,000 times
5. Meetings	– 76,585,000 people attending
6. Training local leaders	– 1,235,000 leaders trained
7. Result demonstrations	– 193,000 demonstrations made
8. News articles	– 823,000 articles published
9. Television and radio broadcasts:	
Television	– 20,000 times
Radio	– 228,000 times
10. Bulletins	– 27,800,000 copies distributed
11. Activities of local leaders	– 1,245,162 meetings held by them without county extension workers being present, witn an attendance of 19,833,000.

As a result of their extension activities, county extension agents estimated that a total of 9,635,000 families were assisted to make some change in agricultural and home-making practices in 1955. Of this total number, 42.4 per cent were farm families, 21.1 per cent were rural non-farm families, and 36.5 per cent were urban families.

In all these steps and methods of program planning and execution, as reviewed above, there is, of course, always room for improvement through constant investigation and evaluation.

In the Federal Extension Service of the U.S. Department of Agriculture, there is a Division of Extension Research, which undertakes field studies or research in extension, in cooperation with the state colleges of agriculture. It was reported that at present about one half of the state colleges in the country were cooperating in the undertaking.

IX. Conclusion—A Big Contrast

Farming in the United States is now highly mechanized and also very much commercialized. To operate a farm requires a big investment and special technical skills. In Madison County, New York, one farm operator on the average raises 39 dairy cows and grows his own feeds. To run a farm in the country is just like running an industrial plant, involving capital investment, efficient management, credit and marketing facilities.

It is hoped that the farm labour income can be comparable to that of any city industrial labour income. Besides, he is the boss of his own farm. If there is any farming problem of economic importance in the country it seems to be a problem of over production, creating difficulties in storage and marketing. All these are in direct contrast to the situation presently obtaining in Asia and the Far East.

This raises the problem of the advisability and suitability of bringing people from underdeveloped areas to the United States for observation and training. From the above discussion, it is evident that only few people can get the full benefit of their visits to the United States. Some people may even get lost in the complexity of things they have seen there. Only experienced people can comprehend the philosophy and principles that underlie all the agricultural improvement activities in the United States, appreciate what can be done in agricultural improvement, and try to work out their own solutions under their own environment and in the light of their observations. This means that a more careful selection of people for training in the United States, as well as more adequate briefing before leaving for the United States, is very necessary.

References

1. Report of the Secretary of Agriculture, 1956. The Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., U.S.A.
2. Extension Activities and Accomplishments, 1955, U.S. Department of Agriculture. Extension Service Circular No. 509, May 1956.
3. Evaluation in Extension. U.S.D.A., Federal Extension Service, Division of Extension Research and Training. June 1956.
4. Careers Ahead. Published by the Association of Land–Grant Colleges and Universities, Washington, D.C., 1955.
5. Rural Development Program Guide (Organization and Objectives) and Supporting Goverment Services, U.S. Department of Agriculture, Washington, D.C., November 1956.

REVIEW OF "RICE IN INDIA"[1]

N. Parthasarathy

Regional Rice Improvement Expert
FAO Regional Office for Asia and the Far East
Bangkok, Thailand

The publication of the monograph on "Rice in India" is welcomed, as an authentic compilation of the useful information available in India on the various aspects of production, marketing, processing and consumption of rice, the staple food of nearly

[1] *"Rice in India" by Ghose. Ghatge and Subrahmanyan, published by the Indian Council of Agricultural Research, New Delhi. Price: Rs, 24.00 in India, $ 7.00 or 47 Shillings (abroad).*

half the world's population. This monograph is the result of an endeavour on the part of the Indian Council of Agricultural Research to bring about a series of monographs for several important crops of India providing "compendiums of information for research workers as well as for students". "Rice in India" was published as the first of the series to comply with the decision of the National Rice Commission, New Delhi, India, made in April 1956 for distribution at the 5th Session of the International Rice Commission, held in Calcutta in November of the same year. Considering the short period of time at their disposal, the authors deserve congratulations for the admirable work they have accomplished.

The presentation of the results of research accumulated during the past five decades in the fields of agronomy, genetics, breeding, insect pests, fungus diseases etc. in the different States of India as well as the information on the marketing and consumption of rice should prove of value not only to rice technicians in India but also to other countries, particularly those countries interested in the culture of varieties belonging to *indica* group of rice.

The book is divided into 3 parts. The first and major part is subdivided into 3 sections, covering general aspects of rice production, research and extension. Such topics as rice history, botany, climate, soils, fertilizer, irrigation, diseases and insects, breeding, genetics, cytology, seed multiplication and distribution are all treated in detail. This part concludes with a chapter on "Japanese Methods of Rice Cultivation", with a view to promoting intensive cultivation of rice in the whole of India.

The second part of the book deals with marketing problems of rice and the data provided therein would be of interest to rice economists. The third part presents some technical information on rice processing, especially parboiling, and the nutritive value of rice, with suggestions for cheap and well-balanced diets for rice consumers.

Rice breeders would certainly be interested in the information given on the agronomic qualities of the many superior strains evolved by various State departments of agriculture in India. Considering the widely varying ecological conditions under which rice is grown in India, there is a good possibility for other countries to introduce some appropriate strains for trying out purposes. The Appendix IV at the end of Part I gives tabulated information on these improved strains, and it is suggested that the list could be made more complete by including grain measurements such as length and breadth for each of these strains. An introductory statement on the methods of their improvement would also be a useful addition.

An interesting finding on the importance of early planting is given on pages 210-11 under Agronomy. A reduction of from 25-50 per cent in yield would occur if the planting were delayed by one or two months. This matter deserves a special attention, because such delays are common in areas, where the crop is solely rain-fed. In countries like Java, China (Taiwan), British Columbia and parts of Venezuela, rice is cultivated throughout the year without reduction in yield by growing varieties indifferent to changes in day length. The

bulus or *javanicas* of Indonesia with a maturity period from 145 to 160 days and the newly bred indica varieties in Java like *Bengawan* and *Ramadja* with about the same maturity are practically non-photo-sensitive. It is therefore evident that indiffesence to day length is not absolutely linked with genetic factors governing yield, and rice breeders in the future should aim at the introduction of this character of non-sensitivity in their commercial varieties to permit wider adaptability.

The statement made on page 11 in Chapter 2, which says that *javanica* rice is not of great importance in agriculture, is not quite correct and should be changed. It is of great commercial importance in Indonesia where it is cultivated in half the rice area in Java and all over the islands of Bali and Lombok.

In dealing with all aspects of a subject, particularly when sections are written by different authors, a certain amount of repetition is unavoidable. To some extent this could be reduced if the chapters on diseases and pests under Sections A and B were condenced into one section.

Those who are engaged in rice improvement work will surely find this publication useful and interesting. It is hoped that the few changes, suggested above, could be incorporated in the second edition.

		Price in U.S.$
No. 18	Cadastral Surveys and Records of Rights in Land, by Sir Bernard O. Binns, 1953. 67 p.	0.50
19	Zebu Cattle of India and Pakistan, by N.R. Joshi and Ralph W. Phillips, 1953. 256 p.	3.00
20	Soil Surveys for Land Development, by C.G. Stephens (Ed.), 1953. 110 p.	1.00
21	Legumes in Agriculture, by R.O. Whyte, G. Nilsson Leissner and H.C. Trumble, 1953. 367 p.	3.00
22	Agricultural Development and Rural Reform in Denmark, by F. Skrubbeltrang, 1953. 320 p.	3.00
23	Milk Pasteurization–Planning, Plant, Operation and Control, by H.D. Kay, J.R. Cuttell, H.S. Hall, A.T.R. Mattick and A. Rowlands, 1953. 204 p.	2.50
24	Joint FAO/WHO Expert Committee on Brucellosis, Second Report, 1953. 36 p.	0.25
25	Advances in the Control of Zoonoses, Bovine Tuberculosis, Leptospirosis, Q Fever, Rabies, 1953. 275 p.	3.00
26	Inter-Relationship between Agrarian Reform and Agricultural Development, by Erich H. Jacoby, 1953. 65 p.	0.75
27	Essentials of Rural Welfare, by the Rural Welfare Branch, 1949, 1953. 43 p.	0.50
28	Plantation and Other Centrally-Operated Estates, by Sir Bernard O. Binns, 1955. 41 p.	0.50
29	Training Rural Leaders, 1949. 135 p.	1.50
30	First Report of the Joint FAO/WHO Expert Committee on Meat Hygiene, 1955. 52 p.	0.60
31	Public Lands, by Andrew W. Ashby, 1956. 47 p.	
32	Vibrio Fetus Infection of Cattle, by J.A. Laing, 1956. 51 p.	

PRINTED BY PRAYAT JATAPUTRA AT UDOM PRESS
395-401 NEW ROAD, BANGKOK 1/4/2501